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IMPROVEMENTS IN THE VERNIER CHRONOSCOPE.

By E. C. SANFORD.

While the vernier chronoscope as described in Vol. IX of this *Journal* has given general satisfaction, continued use of it has suggested several improvements, some of which have been embodied in two new models of the instrument. Model I has been given a convenient device for adjusting the pendulums at their proper lengths and a new and solidier sort of releasing key, without radical change in the general form of the instrument. Model II has these improvements and also a double release key for the shorter pendulum, adapting the instrument to experiments involving discrimination and choice, and an elec-

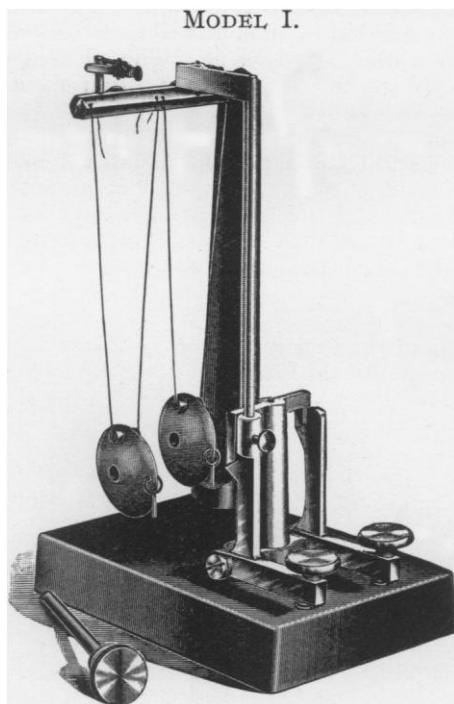


Fig. 1.

trical contact in connection with the release key of the longer pendulum, which greatly increases the variety of stimuli that can be used with it. These changes have involved a considerable remodeling of the instrument.

Adjustment of the Bobs. It will be noticed in the accompanying cut of Model I that both bobs and the supporting post at their right are pierced with sizable holes. The upper one of the holes in the post is bored at such a point that when a close fitting rod is slipped through it and through the hole in the bob of the short pendulum the latter will have its proper distance from the edge of the bar from which the pendulums hang. The lower hole is similarly placed with reference to the bob of the long pendulum.

To hang the bobs at their proper distance all that is necessary is to slip the rod through the appropriate hole in the post, slide on one of the bobs till it reaches its proper position, pass the thread twice through the small hole in the bob, draw the threads straight and withdraw the rod.¹

Keys and Releasing Apparatus. The improvements in this part of the apparatus consist in bringing the keys much nearer the base and in making them more solid. The need of vertical adjustment has been obviated by careful construction. The links, which in the old form of the instrument were separate and liable to be lost, are now permanently attached to the bobs. Among minor points of improvement may be mentioned the increased weight and larger surface of the base, the better shape of the bobs and supporting bar, a simplified means of fastening the threads, the placing of the holder for the stimulus card on the bar from which the pendulums hang,² and the attachment of the screen holder to the operator's key by a socket and set-screw.

¹ If the setting of the bobs is to be the same from time to time it is necessary of course that the threads be drawn up each time with the same degree of tension. It is clear also that any error in the position of the holes in the post and any looseness of the rod in the holes will affect the length of the pendulums, though when the threads are drawn tight the latter is not important. The holes, however, are placed with care and the errors arising from this source are small, and perhaps for practice work might be wholly neglected. Where more exact results are desired the swings may be counted and the pendulums adjusted by count, or an arithmetical correction applied as explained in the *American Journal of Psychology*, Vol. IX, p. 194, and in Titchener's *Experimental Psychology* (Instructor's Manual), p. 213.

² This improvement, which has been used in a considerable number of instruments of the old model, was suggested by Miss Hattie E. Hunt, late of the Rhode Island State Normal School, Providence.

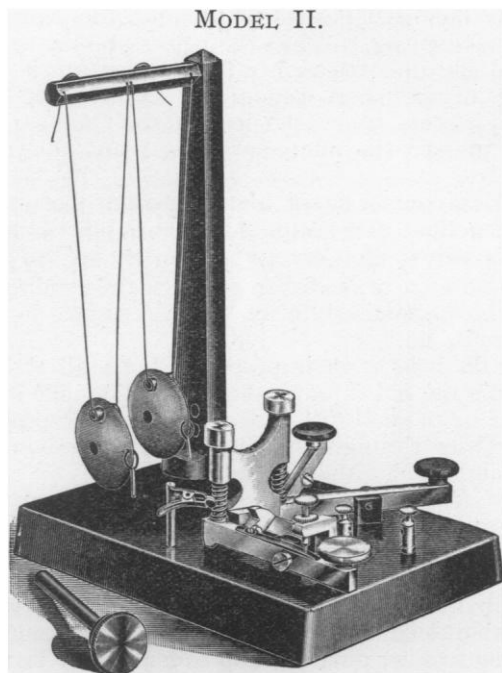


Fig. 2.

The instrument in the form just described has a tolerably wide field of usefulness, as may be seen by consulting the original description in this *Journal* or Titchener's *Primer of Psychology*, pp. 182 ff. It does not, however, lend itself easily to experiments requiring the discrimination of two stimuli and the choice of a reaction appropriate to one or the other, nor does it allow the taking of simple reactions with stimuli of variable character, intensity or place, nor, in a very satisfactory way, of those with visual and electrical stimulation. These are all made possible by the addition of a second key to the releasing apparatus of the shorter pendulum and of electrical contacts to the release key of the longer pendulum. The instrument in this form is shown in Fig. 2. The pendulums, supporting bar and post are like those of Model I, and the base differs only in being about an inch wider. The new release mechanism made necessary by the doubling of the short pendulum key (and used in this instrument for the long pendulum also) will be readily understood from Fig. 3, which shows it in section as used for the latter.

The link of the pendulum is held between a sloping boss and

the conically hollowed head of a plunger, the plunger being kept down by a spring. When the key is pressed the plunger is raised and the link released. The mechanism is the same in the case of the short pendulum, except that the ends of both keys come under the foot of the plunger, so that if either is pressed the plunger is raised and the pendulum released.

The electrical contact fitted to the operator's key is of very simple construction. One contact surface is placed on a spring on the upper side of the key and the other on the point of a

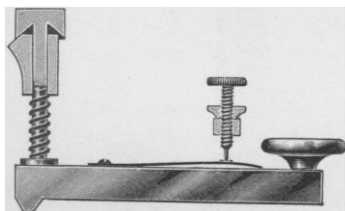


Fig. 3.

screw above it. The lower contact is placed on a spring in order to insure good electrical connection without interfering with the grip of the plunger on the link of the pendulum. The electrical circuit leads through the spring, the body of the key and the base to a binding post attached to the latter. The upper contact is of course connected with a binding post which is insulated from the base. By means of these binding posts the operator's key may be brought into the primary circuit of an induction coil, which on the depression of the key will be broken at the same instant that the long pendulum is released. By the use of the induction coil thus introduced are made possible the various forms of experiment mentioned above. When, for example, the secondary terminals of the coil are connected with a Geissler tube, the apparatus can be used for simple reactions to visual stimuli; when connected with suitable electrodes, for reactions to electrical stimulation of the skin; and when connected with a telephone, for auditory stimuli of a very convenient kind. If the induction coil is of the sliding pattern common in physiological laboratories, stimuli of varying intensity of any one of these sorts can be given by changing the distance of the secondary coil from the primary. Stimuli in variable place can of course be obtained by putting in several Geissler tubes, pairs of electrodes, or telephones in parallel circuit, and using one or another without the previous knowledge of the subject.

The change in the releasing mechanism necessitated a change in the clips for holding the stimulus card and the screen. The

former is placed on a short post on the base near the left end of the operator's key, and the latter is attached to a cam on the opposite side, which is turned by the depression of the key. These clips are shown without the card and screen in the general view, Fig. 2.

With an instrument of this pattern all the more important experiments upon the time relations of mental phenomena are possible, except those requiring the exact measurement of the time elapsing between a spoken stimulus word and a spoken reply by the subject; and even here, with a little practice the operator can learn to depress his key at the giving of the stimulus word (and the subject his key at the giving of his reply) with ample exactness for all purposes of demonstration and even of research.